

## NPN 5 GHz wideband transistor

T-33-05

BFP96

PHILIPS INTERNATIONAL

56E D ■ 7110826 0045374 780 ■ PH

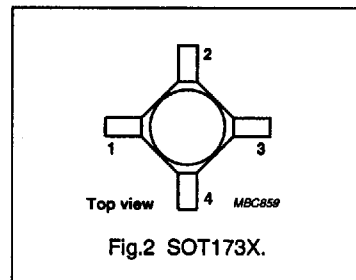
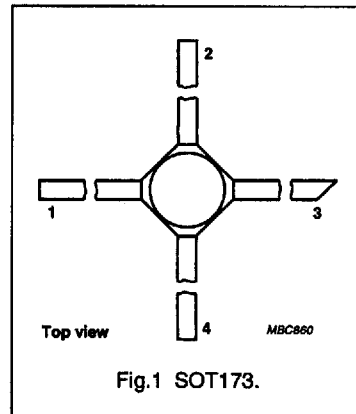
## DESCRIPTION

NPN transistor in hermetically sealed sub-miniature SOT173 and SOT173X micro-stripline envelopes. It features low noise, high gain and low distortion figures and is primarily intended for RF wideband amplifiers and applications up to 1 GHz.

PNP complement is BFG32C.

## PINNING

| PIN      | DESCRIPTION                           |
|----------|---------------------------------------|
| Code: P6 |                                       |
| 1        | collector                             |
| 2        | emitter                               |
| 3        | base (indicated by a red dot on body) |
| 4        | emitter                               |



## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                     | CONDITIONS                                                                                         | MIN. | TYP. | MAX. | UNIT |
|-----------|-------------------------------|----------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                                                                                       | —    | —    | 20   | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                                                                                          | —    | —    | 15   | V    |
| $I_C$     | DC collector current          |                                                                                                    | —    | —    | 100  | mA   |
| $P_{tot}$ | total power dissipation       | up to $T_s = 90\text{ °C}$ (note 1)                                                                | —    | —    | 1    | W    |
| $h_{FE}$  | DC current gain               | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $T_j = 25\text{ °C}$                               | 25   | 80   | —    |      |
| $f_T$     | transition frequency          | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ;<br>$f = 500\text{ MHz}$ ; $T_j = 25\text{ °C}$     | —    | 5    | —    | GHz  |
| $G_{UM}$  | maximum unilateral power gain | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ;<br>$f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$ | —    | 19   | —    | dB   |
|           |                               | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ;<br>$f = 800\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$ | —    | 15   | —    | dB   |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector lead.

## NPN 5 GHz wideband transistor

T-33-05

BFP96

PHILIPS INTERNATIONAL

56E D ■ 7110826 0045375 617 ■ PH

## LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                          | MIN. | MAX. | UNIT |
|-----------|---------------------------|-------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                        | —    | 20   | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                           | —    | 15   | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector                      | —    | 3    | V    |
| $I_C$     | DC collector current      |                                     | —    | 100  | mA   |
| $P_{tot}$ | total power dissipation   | up to $T_s = 90\text{ °C}$ (note 1) | —    | 1    | W    |
| $T_{stg}$ | storage temperature       |                                     | −65  | 150  | °C   |
| $T_j$     | junction temperature      |                                     | —    | 175  | °C   |

## THERMAL RESISTANCE

| SYMBOL        | PARAMETER                                           | CONDITIONS                          | THERMAL RESISTANCE |
|---------------|-----------------------------------------------------|-------------------------------------|--------------------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | up to $T_s = 90\text{ °C}$ (note 1) | 85 K/W             |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector lead.

## CHARACTERISTICS

 $T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL    | PARAMETER                              | CONDITIONS                                                                                                            | MIN. | TYP. | MAX. | UNIT |
|-----------|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{CBO}$ | collector cut-off current              | $I_E = 0$ ; $V_{CB} = 10\text{ V}$                                                                                    | —    | —    | 100  | nA   |
| $h_{FE}$  | DC current gain                        | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$                                                                         | 25   | 80   | —    |      |
| $C_c$     | collector capacitance                  | $I_E = I_s = 0$ ; $V_{CB} = 10\text{ V}$ ; $f = 1\text{ MHz}$                                                         | —    | 1.3  | —    | pF   |
| $C_e$     | emitter capacitance                    | $I_C = I_c = 0$ ; $V_{EB} = 0.5\text{ V}$ ; $f = 1\text{ MHz}$                                                        | —    | 5.5  | —    | pF   |
| $C_{re}$  | feedback capacitance                   | $I_C = 0$ ; $V_{CE} = 10\text{ V}$ ; $f = 1\text{ MHz}$                                                               | —    | 1    | —    | pF   |
| $f_T$     | transition frequency                   | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$                                                  | —    | 5    | —    | GHz  |
| $G_{UM}$  | maximum unilateral power gain (note 1) | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                       | —    | 19   | —    | dB   |
|           |                                        | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 800\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                       | —    | 15   | —    | dB   |
| F         | noise figure                           | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $Z_s = \text{opt.}$ ; $f = 800\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$ | —    | 3.7  | —    | dB   |

## Note

1.  $G_{UM}$  is the maximum unilateral power gain, assuming  $S_{12}$  is zero and  $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$  dB.

T-33-05

## NPN 5 GHz wideband transistor

BFP96

PHILIPS INTERNATIONAL

56E D ■ 7110826 0045376 553 ■ P

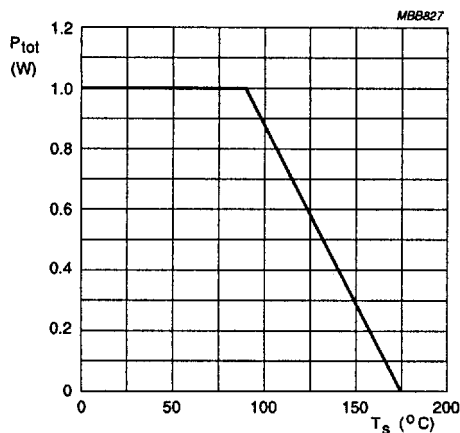


Fig.3 Power derating curve.

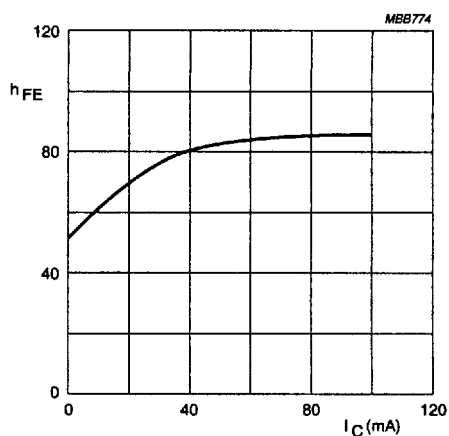
 $V_{CE} = 10$  V;  $T_j = 25$  °C.

Fig.4 DC current gain as a function of collector current.

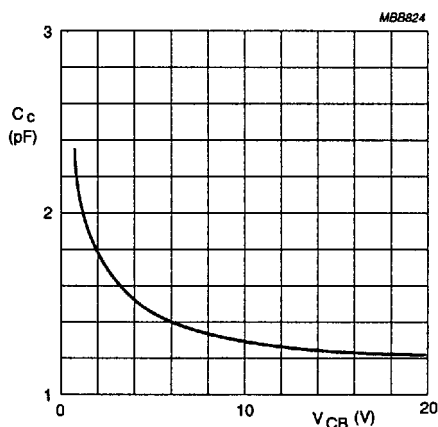
 $I_E = I_o = 0$ ;  $f = 1$  MHz;  $T_j = 25$  °C.

Fig.5 Collector capacitance as a function of collector-base voltage.

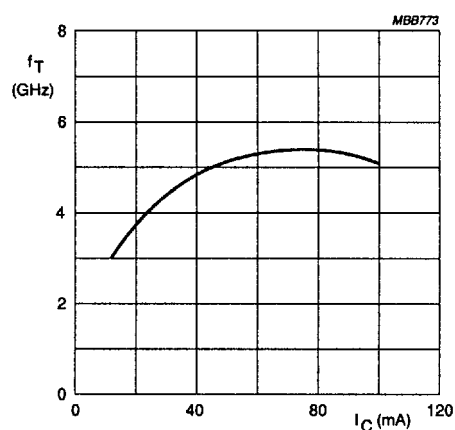
 $V_{CE} = 10$  V;  $f = 500$  MHz;  $T_j = 25$  °C.

Fig.6 Transition frequency as a function of collector current.

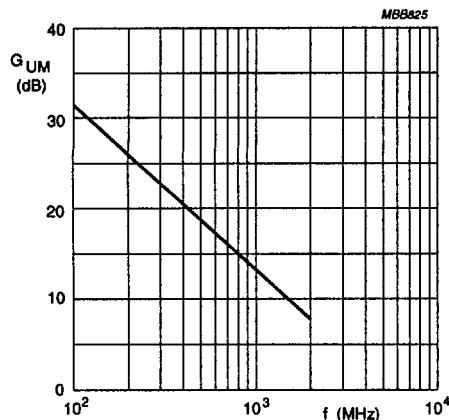
www.DataSheet4U.com  
NPN 5 GHz wideband transistor

T-33-05

BFP96

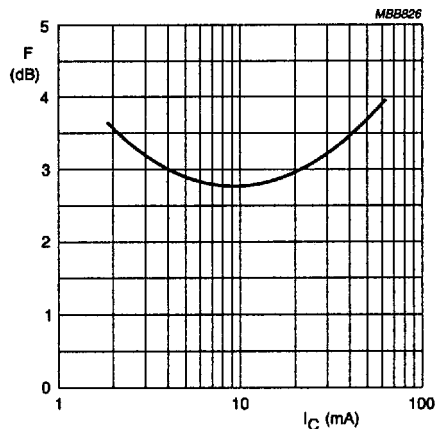
PHILIPS INTERNATIONAL

56E D ■ 7110826 0045377 49T ■ PHI



$I_C = 50$  mA;  $V_{CE} = 10$  V;  $T_{amb} = 25$  °C.

Fig.7 Maximum unilateral power gain as a function of frequency.



$V_{CE} = 10$  V;  $f = 1$  MHz;  $T_{amb} = 25$  °C.

Fig.8 Minimum noise figure as a function of collector current.

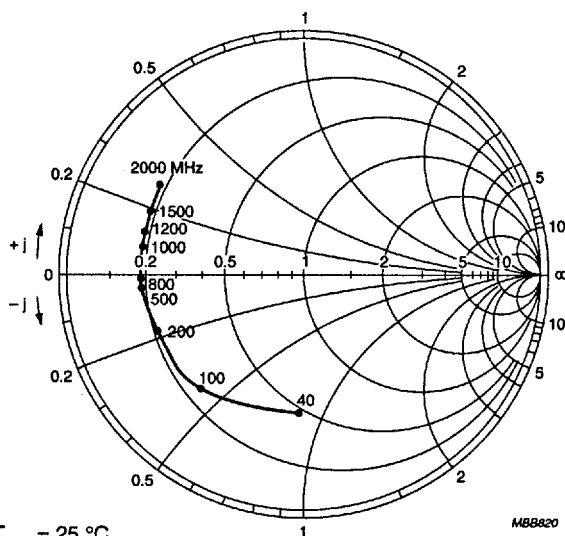
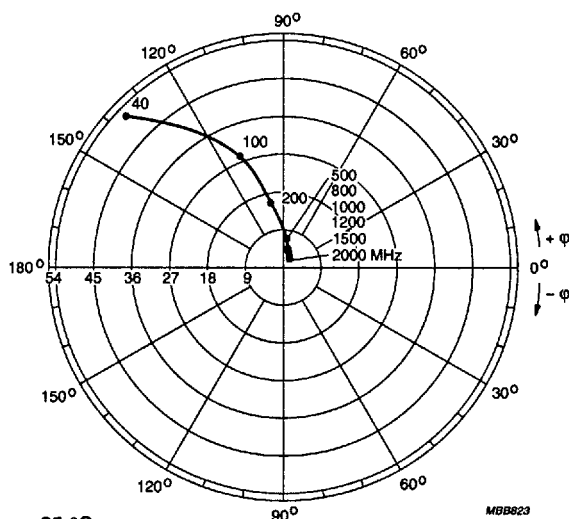
## NPN 5 GHz wideband transistor

T-33-05

BFP96

PHILIPS INTERNATIONAL

56E D ■ 7110826 0045378 326 ■ P

 $I_C = 50 \text{ mA}$ ;  $V_{CE} = 10 \text{ V}$ ;  $T_{amb} = 25^\circ \text{C}$ .Fig.9 Common emitter input reflection coefficient ( $S_{11}$ ). $I_C = 50 \text{ mA}$ ;  $V_{CE} = 10 \text{ V}$ ;  $T_{amb} = 25^\circ \text{C}$ .Fig.10 Common emitter forward transmission coefficient ( $S_{21}$ ).

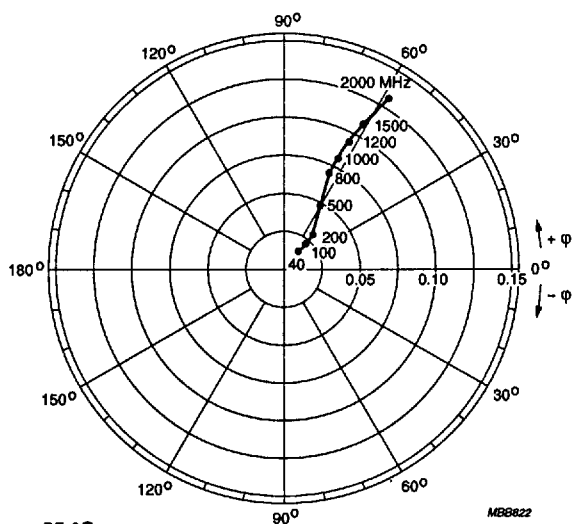
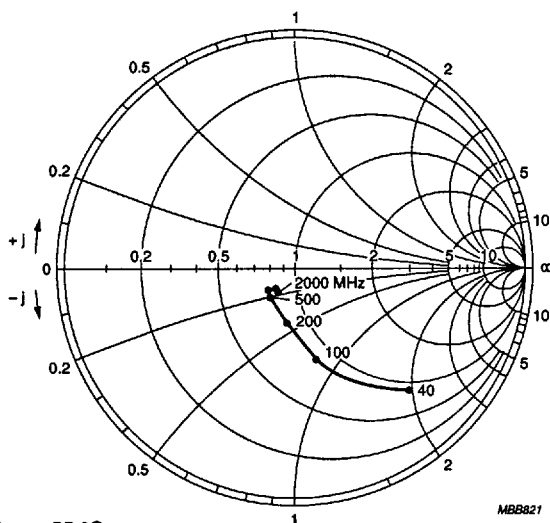
## NPN 5 GHz wideband transistor

T-33-05

BFP96

PHILIPS INTERNATIONAL

56E D ■ 7110826 0045379 262 ■ PHILIPS

Fig.11 Common emitter reverse transmission coefficient ( $S_{12}$ ).Fig.12 Common emitter output reflection coefficient ( $S_{22}$ ).

T-33-05

NPN 5 GHz wideband transistor

BFP96

PHILIPS INTERNATIONAL

56E D ■ 7110826 0045380 T84 ■

Table 1 Common emitter scattering parameters,  $I_C = 50 \text{ mA}$ ;  $V_{CE} = 5 \text{ V}$ 

| f<br>(MHz) | S <sub>11</sub> |               | S <sub>21</sub> |               | S <sub>12</sub> |               | S <sub>22</sub> |               | G <sub>UM</sub><br>(dB) |
|------------|-----------------|---------------|-----------------|---------------|-----------------|---------------|-----------------|---------------|-------------------------|
|            | MAG.<br>(RAT)   | ANG.<br>(DEG) | MAG.<br>(RAT)   | ANG.<br>(DEG) | MAG.<br>(RAT)   | ANG.<br>(DEG) | MAG.<br>(RAT)   | ANG.<br>(DEG) |                         |
| 40         | 0.465           | -121.9        | 50.515          | 138.8         | 0.010           | 62.4          | 0.750           | -44.8         | 38.7                    |
| 100        | 0.656           | -153.2        | 28.622          | 113.6         | 0.016           | 48.5          | 0.437           | -76.5         | 32.5                    |
| 200        | 0.706           | -168.1        | 15.449          | 99.8          | 0.021           | 53.2          | 0.260           | -99.5         | 27.1                    |
| 300        | 0.726           | -174.5        | 10.464          | 93.6          | 0.026           | 57.0          | 0.200           | -112.4        | 23.8                    |
| 400        | 0.734           | -178.3        | 7.933           | 89.2          | 0.032           | 62.5          | 0.176           | -120.1        | 21.5                    |
| 500        | 0.737           | 178.8         | 6.380           | 85.8          | 0.038           | 64.2          | 0.164           | -125.3        | 19.6                    |
| 600        | 0.736           | 176.7         | 5.327           | 83.0          | 0.043           | 65.4          | 0.159           | -129.0        | 18.0                    |
| 700        | 0.736           | 174.3         | 4.601           | 80.5          | 0.049           | 67.2          | 0.153           | -131.1        | 16.7                    |
| 800        | 0.733           | 172.3         | 4.060           | 78.0          | 0.056           | 69.1          | 0.152           | -132.6        | 15.6                    |
| 900        | 0.731           | 170.1         | 3.624           | 76.0          | 0.062           | 69.0          | 0.152           | -133.9        | 14.6                    |
| 1000       | 0.734           | 167.8         | 3.273           | 73.8          | 0.068           | 70.3          | 0.152           | -134.0        | 13.8                    |
| 1200       | 0.739           | 164.2         | 2.746           | 69.8          | 0.081           | 69.9          | 0.158           | -135.4        | 12.3                    |
| 1400       | 0.744           | 161.0         | 2.366           | 65.8          | 0.091           | 69.9          | 0.164           | -136.0        | 11.1                    |
| 1600       | 0.742           | 157.9         | 2.085           | 61.4          | 0.104           | 70.6          | 0.170           | -135.5        | 10.0                    |
| 1800       | 0.733           | 154.1         | 1.880           | 57.7          | 0.119           | 69.4          | 0.176           | -136.7        | 9.0                     |
| 2000       | 0.732           | 150.6         | 1.710           | 54.3          | 0.129           | 69.6          | 0.185           | -138.8        | 8.1                     |
| 2200       | 0.744           | 147.1         | 1.569           | 51.0          | 0.140           | 68.9          | 0.196           | -142.0        | 7.6                     |
| 2400       | 0.744           | 144.8         | 1.411           | 47.7          | 0.150           | 68.3          | 0.213           | -144.8        | 6.7                     |
| 2600       | 0.734           | 142.4         | 1.324           | 44.6          | 0.164           | 68.0          | 0.235           | -145.9        | 6.0                     |
| 2800       | 0.715           | 139.0         | 1.240           | 39.8          | 0.174           | 66.1          | 0.252           | -146.2        | 5.3                     |
| 3000       | 0.703           | 134.6         | 1.181           | 37.2          | 0.186           | 66.2          |                 |               |                         |

## NPN 5 GHz wideband transistor

T-33-05

BFP96

PHILIPS INTERNATIONAL

56E D ■ 7110826 0045381 910 ■ PHILIPS

Table 2 Common emitter scattering parameters,  $I_C = 50$  mA;  $V_{CE} = 10$  V

| f<br>(MHz) | $S_{11}$      |               | $S_{21}$      |               | $S_{12}$      |               | $S_{22}$      |               | $G_{UM}$<br>(dB) |
|------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|------------------|
|            | MAG.<br>(RAT) | ANG.<br>(DEG) | MAG.<br>(RAT) | ANG.<br>(DEG) | MAG.<br>(RAT) | ANG.<br>(DEG) | MAG.<br>(RAT) | ANG.<br>(DEG) |                  |
| 40         | 0.474         | -106.0        | 52.454        | 138.8         | 0.0110        | 58.3          | 0.757         | -40.6         | 39.2             |
| 100        | 0.632         | -145.0        | 29.510        | 113.5         | 0.0170        | 41.4          | 0.435         | -67.4         | 32.5             |
| 200        | 0.672         | -164.0        | 15.987        | 99.9          | 0.0210        | 48.3          | 0.246         | -83.0         | 27.0             |
| 300        | 0.690         | -171.0        | 10.971        | 92.9          | 0.0270        | 57.4          | 0.179         | -90.2         | 23.8             |
| 400        | 0.701         | -176.0        | 8.224         | 89.2          | 0.0320        | 57.7          | 0.148         | -95.2         | 21.3             |
| 500        | 0.700         | -178.0        | 6.528         | 86.3          | 0.0360        | 63.2          | 0.133         | -98.9         | 19.3             |
| 600        | 0.697         | -178.0        | 5.589         | 82.4          | 0.0430        | 65.4          | 0.124         | -101.0        | 17.9             |
| 700        | 0.709         | -175.8        | 4.752         | 79.8          | 0.0490        | 64.5          | 0.119         | -103.0        | 16.6             |
| 800        | 0.696         | -173.1        | 4.216         | 77.4          | 0.0550        | 67.3          | 0.117         | -104.0        | 15.4             |
| 900        | 0.709         | -171.6        | 3.724         | 75.5          | 0.0600        | 65.5          | 0.116         | -106.0        | 14.5             |
| 1000       | 0.704         | -168.6        | 3.391         | 72.6          | 0.0660        | 67.6          | 0.117         | -107.0        | 13.6             |
| 1200       | 0.712         | -165.7        | 2.817         | 68.2          | 0.0780        | 67.6          | 0.122         | -111.0        | 12.1             |
| 1400       | 0.720         | -162.2        | 2.464         | 64.9          | 0.0890        | 67.0          | 0.129         | -114.0        | 11.1             |
| 1600       | 0.711         | -158.2        | 2.131         | 59.7          | 0.101         | 67.1          | 0.138         | -116.0        | 9.71             |
| 1800       | 0.707         | -154.8        | 1.944         | 55.7          | 0.114         | 66.7          | 0.145         | -118.0        | 8.88             |
| 2000       | 0.725         | -151.3        | 1.766         | 53.4          | 0.124         | 66.4          | 0.152         | -123.0        | 8.28             |
| 2200       | 0.719         | -147.0        | 1.624         | 48.3          | 0.133         | 66.2          | 0.164         | -130.0        | 7.49             |
| 2400       | 0.720         | -144.4        | 1.474         | 46.2          | 0.142         | 64.7          | 0.182         | -135.0        | 6.69             |
| 2600       | 0.718         | -142.8        | 1.351         | 40.9          | 0.155         | 64.7          | 0.206         | -138.0        | 5.95             |
| 2800       | 0.709         | -138.9        | 1.265         | 36.6          | 0.165         | 62.7          | 0.220         | -140.0        | 5.29             |
| 3000       | 0.700         | -135.1        | 1.207         | 33.6          | 0.174         | 63.4          | 0.230         | -143.0        | 4.79             |